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1996-97 School Year

Mathematics 33 Information Bulletin

Diploma Examinations Program

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Students First!
nt Evaluation

Alberta
EDUCATION

This document was written primarily for:

Students	✓
Teachers	✓ Mathematics 33 teachers
Administrators	✓
Parents	
General Audience	
Others	

Distribution: Superintendents of Schools • School Principals and Teachers • The Alberta Teachers' Association • Alberta Education • General Public upon Request

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Purpose of the Bulletin

The purpose of this bulletin is to provide students and teachers of Mathematics 33 with information about the diploma examinations scheduled for 1997.

We encourage teachers to share the contents of this bulletin with students and to review the scoring criteria with them.

If you have requests, questions, or comments about the contents of this bulletin, please contact:

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To call toll-free from outside of Edmonton, dial 310-0000.

Important Dates in the 1996-97 School Year

Administration of the Examination

1997 Administrations	*Time**
Tuesday, January 28	9:00–11:30 A.M.
Wednesday, June 25	9:00–11:30 A.M.
Friday, August 15	9:00–11:30 A.M.

* The diploma examination is designed for a writing time of 2.5 h. Students may have an additional 0.5 h to complete the examination.

Please consult the *General Information Bulletin, Diploma Examinations Program*, for a complete schedule for all subject areas.

Scoring of the Examination

1997 Administrations	*Scoring Dates***
January	February 11 and 12 (Head Markers) February 13 to 15
June	July 5 and 6 (Head Markers) July 7 to 9
August	August 22

** Dates are tentative and will be confirmed by telephone with markers.

Notes of Interest

Information About Markers

The written-response questions of the Mathematics 33 Diploma Examinations are marked by Mathematics 33 teachers selected from those who have been recommended as markers to the Student Evaluation Branch by their superintendents. To qualify for recommendation, a teacher must have taught the complete Mathematics 33 course twice, be teaching the course in the current school year, and have an Alberta or Northwest Territories Permanent Professional Teaching Certificate.

Often, more teachers are recommended as markers by superintendents than are required by the Student Evaluation Branch for any one marking session. The following criteria are considered when markers are selected for a particular marking session:

- experience as a marker (experienced markers and first-time markers are included)
- regional representation (by zone, jurisdiction, and school)
- student population (proportional representation)

We particularly need teachers who can mark examinations written in French.

Teachers who wish to be recommended as markers for the January 1997 examination should contact their superintendents by **September 27, 1996**. Teachers who wish to be recommended as markers for the June and August 1996 examinations should contact their superintendents by **February 28, 1997**.

Item Writing and Field Testing

As the need arises for teachers to participate in field testing and item writing, letters are sent to superintendents requesting their nominations. **Teachers who are interested in these activities should let their superintendents know by September 27, 1996.**

Reports

After each January and June administration of the Mathematics 33 diploma examination, copies of the *Examiners' Report* for that particular administration are sent to teachers in all senior high schools in Alberta. The report contains provincial results along with comments about student performance on the examination.

Examiners' reports are designed for teacher use. If we can make these reports more useful to you, please let us know.

School and Jurisdiction Statistical Reports are sent to each superintendent and senior high school principal after each January and June administration of the Mathematics 33 diploma examination. These reports provide detailed information on how well the students in their school district and school, respectively, did on the Mathematics 33 diploma examination. Teachers may use these data to reflect on the areas of the program where their students did well and those areas where student performance was poor.

Each year, the Student Evaluation Branch produces the *Annual Report, Diploma Examinations Program*. This report contains information about the results achieved by all students who wrote diploma examinations in the preceding school year. It also contains special studies on topics of interest. The first annual report (1989–90 school year) contains a study comparing achievement in various diploma courses. The second report (1990–91 school year) contains a study comparing the achievement of students who repeat diploma examination courses and rewrite diploma examinations with their achievement the first time and with the achievement of students who write only once. The third report (1991–92 school year) contains a study of participation rates in diploma examination courses. The fourth report (1992–93 school year) contains a study of English 30 students' application of conventions of language. The fifth report (1993–94 school year) presents a comparison of provincial participation rates in diploma examination subjects for the school years 1991–92, 1992–93, and 1993–94. The sixth report (1994–95 school year) examines declining enrollment of Grade 12 students. Each of these special studies will be of interest to teachers who are involved in interpreting diploma examinations results of their students.

Additional copies are available from the student Evaluation Branch.
Phone: 427-0010 FAX: 403-422-4200
To call toll-free from outside of Edmonton, dial 310-000.

As of the 1995-96 school year, this report is available on the Internet at Alberta Education's Web Site (http://ednet.edu.gov.ab.ca).

Inservices and Presentations

On a limited basis and subject to budget constraints, Student Evaluation Branch staff is available to provide inservices or presentations related to diploma examinations or the interpretation of diploma examination results.

Student Use of Scientific Calculators

Examinations are constructed to ensure that the use of particular scientific calculators neither advantages nor disadvantages individual students. Students are expected to provide their own scientific calculators.

Refer to Appendix A for the policy statement on the use of scientific calculators on diploma examinations. Students should be made aware of this policy as early as possible in the school term to ensure they are able to use the scientific calculator of their choice when writing examinations. **Students should be aware that notes stored in electronic devices must not be brought into the examination room.**

Students should also be made aware of the Examination Rules, Grade 12 Diploma Examinations in the *General Information Bulletin*.

Data Resources for Students

A separate data booklet has been provided for the Mathematics 33 Examination. The booklet contains a formula sheet, 90% Box Plots, loan tables, mortgage tables, annuity tables, and present value of an annuity tables. The formulas contained in the data booklet have been recommended by Mathematics 33 teachers across the province; ongoing feedback is encouraged. Procedures for determining annuities and present value of an annuity are illustrated in the curriculum standards contained in Appendix B. The Mathematics 33 Course of Studies recommends using tables rather than calculating annuities using a geometric series. The annuity tables provided are annuity due tables that combine interest and principal in the first period, and which were selected and developed to closely simulate what happens in the real world. Teachers are encouraged to review and copy the tables provided for the June 1996 examination. Note that the updated June version of the data booklet has a navy cover. If you do not have this version, contact the Student Evaluation Branch. The earlier version with the purple cover should be discarded.

Guide for Students

NEW

A publication written for students called *Students First: A Guide for Students Preparing to Write the Mathematics 33 Diploma Examination* is available in each senior high school. See your principal or department head for the black line master. This publication contains suggestions for exam preparation and exam writing suggestions.

The Student Evaluation Branch highly recommends that students and teachers examine this document early in the term to prepare for the Mathematics 33 Examination. Parents will also find this to be a useful publication.

Student Requests for Rescores

Students may request a rescoring of their diploma examinations. Before applying for a rescoring, students should check their Diploma Examination Results Statement to find out the distribution of marks. The mark on the machine-scored questions is not likely to change as a result of a rescore, but the written-response mark could change slightly. Students should remember that the rescored mark will be the final mark whether it *increases* or *decreases*.

Students who decide to have an examination rescored must ensure that their application is received before the deadline specified on the results statement. The fee for rescoring each examination is $26.75, which includes GST. If a diploma examination mark is increased by 5% or more as a result of rescoring, the fee is refunded.

Student Requests for Rewriting

Students may rewrite a diploma examination in any regularly scheduled administration. Students must apply to the Student Evaluation Branch by November 15, 1996, and April 15, 1997, to be eligible to write the January and June diploma examinations. The tentative fee for rewriting each examination is $26.75, which includes GST. (For more details, see the *General Informaton Bulletin*.)

Mathematics 33 Information

Standards

Standards are statements that communicate how well a student needs to perform in order to be judged as having met the required learnings specified for Mathematics 33. Accordingly, the learnings for Mathematics 33 are referred to in the Mathematics 13–23–33 Program of Studies as the specific knowledge, skills, and attitudes that students should have. These learnings are amplified as standards in Appendix B, Mathematics 33 Curriculum Standards. The standards are applicable to students who achieve an acceptable standard of achievement but not the excellent standard of achievement (who receive a final course mark of between and including 50% and 79%) and students who achieve an excellent standard of achievement (who receive a final course mark of 80% or better). Specific statements of standards in Appendix B are written primarily to inform teachers about the extent to which students must know Mathematics 33 content and must demonstrate the skills to pass the examination. Examples of questions are provided to give a profile of the acceptable and excellent standards of achievement.

Examination Specifications

In keeping with the expectations listed in the *Senior High Program of Studies for Mathematics 33*, the 1997 examinations will reflect the need to understand ideas that make up concepts and the relationships between concepts. Most importantly, the examination will reflect the need to apply understanding of concepts and procedures to solving problems.

Each Mathematics 33 diploma examination is designed to reflect the general and specific learner expectations outlined in the *Senior High Program of Studies for Mathematics 33*, revised May 1991. Some questions will assess specific learner expectations, whereas other questions will be based on the integration of several learner expectations. In relation to curriculum content and the general outcomes specified in the curriculum standards document, questions may be presented that assess students' overall understanding in content areas.

As well, a question or set of questions may assess understanding from a number of core content areas. Questions are organized into sets for a variety of reasons. Sets of questions are used to provide context and connect the large areas of understanding that a student must have. Individual sets of questions are referred to as scenarios; any examination may contain four to five scenarios.

Questions organized into scenarios assess students' ability to realize general learner expectations. In this, students need to use their mathematical understandings to apply, analyze, investigate, interpret, make decisions, and solve problems related to real-world phenomena (future endeavors, employment situations, and everyday life).

An example of a scenario that is used to challenge students to make and apply mathematical connections is the "Connections" scenario. This scenario provides an opportunity for students to show that they can link mathematical understandings to real-world situations, to other disciplines, or between different topics within the field of mathematics.

Based on the premise of what students need to learn, teacher item-writing committees, post-secondary institutions, business partners, and steering committees have recommended that the scenario format of the examination reflect students' ability to confidently transfer known mathematical skills to new or existing practical situations.

Questions will be organized according to the following list of general scenario topics:

1. Alberta Industries
2. Consumerism
3. Connections
4. Science and Technology
5. Sports and Recreation

These topics were chosen for their relevance to the current program of studies and to the students' post-secondary needs and opportunities.

Teachers have been involved in writing the scenario questions in applied and pure mathematical contexts. Businesses and post-secondary institutions have been involved in making curriculum connections and providing data for questions.

Format

The 1997 examinations will use the same examination format as the 1996 administrations. That is, the examinations will have both machine-scored and teacher-scored (written-response) questions distributed throughout the examinations and within the sets of questions.

The machine-scored questions will be of two types: multiple choice and numerical response. Students will record their answers to machine-scored questions on the form found in Appendix E. Special instructions for filling in answers to numerical-response questions can be found in Appendix F.

Each examination will contain four written-response questions. Three will be equal in value (5 marks), and the fourth question worth slightly more (6 marks). Student answers to the written-response questions will be scored by teachers using holistic scoring guides. The scoring guide describes the characteristics of an answer, which correspond to a number on a scale. The scale is appropriately proportioned to the task or question being scored and can vary between zero and six marks. Each student's answer will be scored by one teacher. A sample of a question and a holistic scoring guide are provided in Appendix G. The generalized five- mark guide is one that can be adapted to future examination questions.

Written-response questions will require students to describe their method of problem solving and to communicate their descriptions of mathematical concepts and procedures. Clear communication includes the proper use of mathematical syntax.

As previously mentioned, the examination may contain five to seven scenerios (sets of questions). Scenarios are introduced in a bordered area of the examination with a title, caption, and/or picture. The introduction provides a meaningful context to the set of questions and/or refers students to the major understandings under which questions are organized. Within the scenarios, students may find other bordered areas that provide additional information required to solve the questions that follow.

Some bordered areas may be presented in italics. Italicized areas are intended to provide a link between questions and/or major understandings.

Examination Design

The Mathematics 33 Diploma Examination is designed to reflect content as outlined in the *Senior High Program of Studies for Mathematics 33* (1991). The examination is limited to those expectations that can be measured by a paper and pencil test.

Question Types

The design of the 1997 Mathematics 33 diploma examinations is as follows:

Question Format	*Number of Questions*	*Marks*	*Percent Emphasis*
Written Response	4	21	30
Numerical Response	12	12	17
Multiple Choice	37	37	53

Core Content Emphasis

The core content of the course is used to build the examination. The emphasis was determined by first considering recommendations in the current Teacher Resource Manual and then considering the advice obtained from teacher item-writing committees, the responses to the information newsletter mailed province-wide in the fall of 1994, and the advice of the Mathematics 33 Diploma Examination Steering Committee (July 1995). The emphasis below is used as much as possible to build the examination.

Core Content	*Percent Emphasis*
Powers and Radicals	10
Annuities, Mortgages, and Loans	10
Statistics	13
Trigonometry	18
Polynomial & Rational Expressions	13
Relations and Functions	18
Quadratic Functions & Equations	18

Mathematical Understandings

The three mathematical understandings of procedures, concepts, and problem solving will be addressed throughout the examination. The proposed emphasis of these understandings is listed below.

	Percent Emphasis
Written Response	
Procedures, Concepts, and Problem Solving	30 (combined)
Multiple Choice and Numerical Response	
Procedures	30
Concepts	25
Problem Solving	15

For further information regarding the mathematical understandings above, see Appendix C. For an explanation of the directing words used on examinations, see Appendix D.

Abstract and Concrete Understandings

Students will be required to demonstrate both abstract and concrete understandings in any unit. An example of a concrete understanding is being able to apply knowledge gained in the Annuity, Mortgage, and Loan Unit to one's personal finance or to operating a small business. Abstract understandings are seen, for example, as being used to connect knowledge of quadratic functions to their graphical representations. Concrete understanding in quadratics would relate to applying an equation or graph to a real-world situation. Scenarios will have either an applied or a pure mathematics flavour.

Directions for the 1997 Examinations

Expectations

Recent teacher committees involved in item development and marking have emphasized the need for accuracy in final answers. Students will be expected to provide precise answers that are rounded to the proper degree of accuracy in the final step, unless otherwise indicated. This is also connected to realizing the general learner expectations as described in the *Senior High Program of Studies*.

Scenerios

Students will be required to realize the general learner expectations. In realizing these expectations, scenarios will be used wherein students will need to use mathematical understandings to analyze, investigate, interpret, and make decisions related to real-world phenomena (future endeavors, employment, and everyday life). As well, students will be required to make connections among the various mathematical concepts and between mathematics and other disciplines.

Communication

Teacher diploma exam markers during the past year have insisted that mathematical statements or procedures be clearly communicated with correct syntax. Teachers' committees also endorsed the general learner expectation that students be able to communicate mathematical ideas clearly and effectively. As well, stakeholders have indicated that mathematical literacy is a current skill for employability. For these reasons, the open-ended questions will require students to communicate answers effectively in writing. They may be required to explain a solution, articulate their reasoning, describe a mathematical situation, write directions to a problem, pose questions, and/or explain new understandings. As well, students are expected to provide a concluding statement complete with a correct answer and relevant units.

Problem Solving

The written-response questions will focus on students' understanding of the problem-solving process, and students will be rewarded for selecting and carrying through a problem-solving strategy. Effectively communicating solutions will enhance student grades on the written-response component of the examination. Over the past year, several students neglected to articulate the correct answer with proper units. For purposes of the 1997 diploma examinations, teachers have asked us to emphasize that the expectation for full credit will be that the solution contain a concluding statement and no communication or syntax errors.

Appendices

Appendix A

Calculator Policy

POLICY: USE OF CALCULATORS ON ALBERTA EDUCATION DIPLOMA EXAMINATIONS

Background

The knowledge, skills, and attitudes relevant to technology and its uses are being incorporated into courses and programs of study wherever appropriate. Students are expected to learn the advantages and limitations of technological developments and their impact upon society. The ability to use technology helps students understand and appreciate the process of technological change, gives added depth to programs, and provides the basis for the development of skills and understanding. These expectations are reflected in the diploma examinations. Since the data provided for writing diploma examinations in mathematics and the sciences do not include information such as logarithms and trigonometric functions, students will need to use scientific calculators for these exams.

Definition

This policy considers a scientific calculator to be a hand-held device designed primarily for mathematical computations. Included in this definition are those scientific calculators having graphing capabilities, built-in formulas, mathematical functions, or other programmable features.

Policy

To ensure compatibility with provincial *Programs of Study* and equity and fairness for all students, Alberta Education expects students to use scientific calculators, as defined above, when they are writing diploma examinations in mathematics and the sciences. Examinations are constructed to ensure that the use of particular models of calculators neither advantages nor disadvantages individual students.

Procedures

1. Teachers must, at the beginning of a course, advise students of the types of calculators that they may use when writing diploma examinations in mathematics and the sciences. Teachers must also advise students of the types of information that can be stored in calculators that are brought into diploma examinations. Calculators that have built-in notes (definitions or explanations in alpha notation) that cannot be cleared are not permitted.

2. Students must clear calculators that are brought into diploma examinations of all information they have stored except for
   a. programs used for computing values of the formulas on the diploma examination data tear-out pages or in the data booklets,
   b. programs used for graphing quadratic relations as found in the Mathematics 30/33 Interim Teacher Resource Manual.

3. Students must not bring external devices to support calculators into the exam. Such devices include manuals, printed or electronic cards, printers, memory expansion chips or cards, external keyboards, or any annotations outlining operational procedures for scientific calculators.

4. In preparation for calculator failure, students may bring extra calculators and batteries into the exam room.

5. During exams, supervising teachers must ensure that
   a. all calculators operate in silent mode,
   b. students do not share calculators or information contained within them,
   c. calculator cases are stored on the floor throughout the exam, and
   d. all examination rules are followed.

6. If you have any questions or comments about the implementation of this policy, please contact the Math/Science Unit, Student Evaluation Branch, at 403-427-0010 or FAX 403-422-4200.

Appendix B

Mathematics 33 Standards and Sample Questions

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Page 37 *Powers and Radicals*

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Page 45 *Trigonometry*

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Page 55 *Annuities, Mortgages, and Loans*

Curriculum Standards

Curriculum standards are criteria that can be used to judge when a student has met the expectations of the Program of Studies for a course.

Curriculum standards are statements of what students are expected to know and be able to do. These statements are made in the Program of Studies for Mathematics 33 and have been enlarged upon in this document in order to set the stage for the development of the Diploma Examination. The statements made here represent the Program of Studies and have been organized to include general outcomes for each unit and specific outcomes for each unit. The specific outcomes have been further divided into expectations that will be held for students who demonstrate **acceptable** and **excellent** achievement.

Acceptable Achievement

Students who demonstrate acceptable achievement but not excellent achievement in Mathematics 33 will receive a final course mark between and including 50% and 79%. Typically, these students have gained new skills and knowledge in mathematics but students at the lower end of acceptable achievement level can anticipate difficulties if they choose to enroll in post-secondary mathematics courses. They have demonstrated mathematical skills and knowledge in seven content strands of the Mathematics 33 curriculum and exhibit an ability to apply a range of problem-solving skills to these content strands.

Excellent Achievement

Students who demonstrate excellent achievement will receive a final course mark of 80% or higher. Such students have demonstrated their ability and interest in mathematics and feel confident about their mathematical abilities. These students should encounter little difficulty in post-secondary mathematics programs; they should be encouraged to pursue careers in which they will use their talents in mathematics.

Statements

The specific statements of standards that follow were written primarily to inform Mathematics 33 teachers about the extent to which students must know the Mathematics 33 content and must demonstrate the required skills to pass the examination.

Examples

A limited number of examples are provided for each section of the course. The questions provided are by no means exhaustive and have been coded to reflect the acceptable and excellent outcomes and are indicative of the type of questions that students will be presented with in the formal examination. The questions were contextualized into scenarios at an earlier stage of development, so teachers and students are advised to look at

copies of the 1996 diploma examinations to get a better sense of the scenario format. The examples that follow are merely intended to give a sense of what is required at the acceptable and excellent levels of achievement.

Relations and Functions

Students who achieve the standards can demonstrate the following general outcome upon completion of the unit:
Apply the concepts within relationships and functions to describe real-world phenomena that can be expressed in two variables.

Illustration of the general outcome
Given an everyday situation, students can construct a graphical model of it, analyze it, and then generalize the model to other situations.

The student demonstrating acceptable achievement can:
- interpret, orally or in writing, a graph that models a real-world situation
- create a graph that models a real-world situation
- identify the dependent and independent variables from the graph of a function
- explain why the independent variable is independent in a given context
- describe, orally or in writing, the domain and range of any function, except the reciprocal function, by examining its graph or a set of ordered pairs
- interpolate from graphs of continuous functions
- extrapolate from graphs of linear functions
- verify whether a point is or is not on the graph of a function
- determine the values of a function given particular domain values
- recognize, illustrate, and classify linear, quadratic, cubic, absolute value, first-degree reciprocal, radical, and exponential functions
- determine the inverse of a function when provided with the graph of the function
- explain and show the effect of a single parameter, a, b, or c on the graph of $y = c \bullet f(x - a) + b$
- participate in and contribute toward the problem-solving process for problems that require the use of functions studied in Mathematics 33

The student demonstrating excellent achievement can:

- state the domain and range of any function, including the reciprocal function, using mathematical notation
- illustrate the relationship between two variables in an everyday situation using a defining rule
- determine whether or not a cause-and-effect relationship exists between two variables, and in the case of such a relationship, decide which of the two variables is the independent variable
- extrapolate from graphs of any functions
- given particular values for a function, determine the corresponding values of the domain
- recognize and classify real-world situations that are depicted as being a linear, quadratic, cubic, absolute value, first-degree reciprocal, radical, or exponential function
- determine the inverse of a function
- explain, orally or in writing, and show the effects of the parameters a, b, and c on the graph of $y = c \cdot f(x - a) + b$
- find the complete solution to problems that require the use of functions studied in Mathematics 33

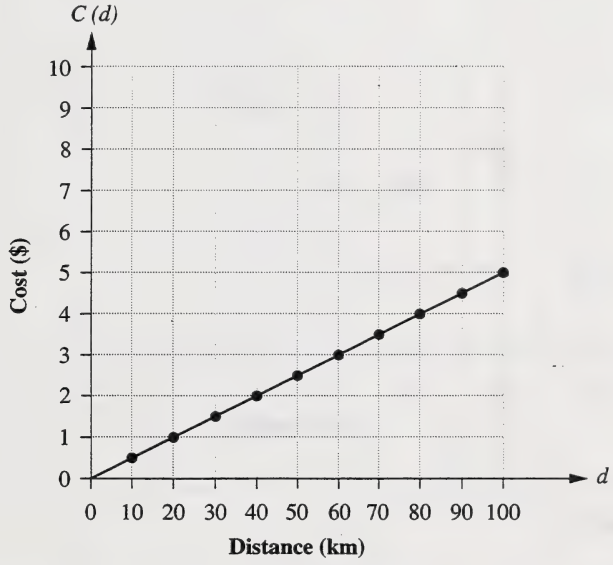
Following are examples of questions from the Relations and Functions Unit that illustrate the standards under the scenario of consumerism.

The student demonstrating acceptable achievement can answer the following types of questions.

SCENARIO: **CONSUMERISM**
Aaron used his knowledge of relations and functions to analyze costs associated with operating a car.

Use the following information to answer the next two questions.

Aaron created the following graph relating the cost of fuel to the distance travelled.



1. Aaron's graph may be considered as being part of the graph of a

A. cubic function
* **B.** linear function
C. quadratic function
D. reciprocal function

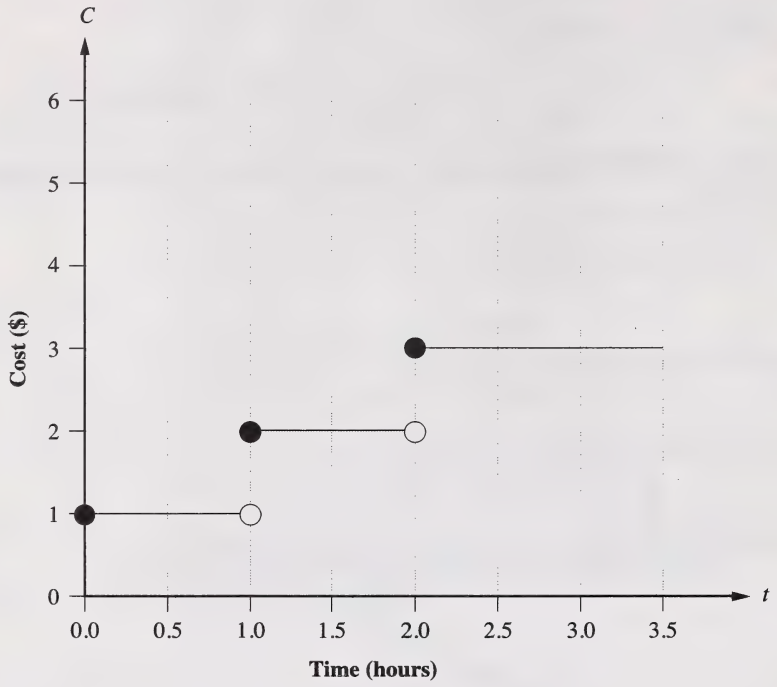
Numerical Response

1. The predicted cost of a 60 km ride, using the graph provided, would be $__3.00__.

(Record your answer to the nearest dollar.)

Use the following information to answer the next question.

The graph below represents the cost, C, in dollars, that Aaron was charged for various lengths of parking time, t, in hours, at a parkade.



Written Response

1. Write a story describing the amount of money Aaron would pay in the three different time intervals shown.

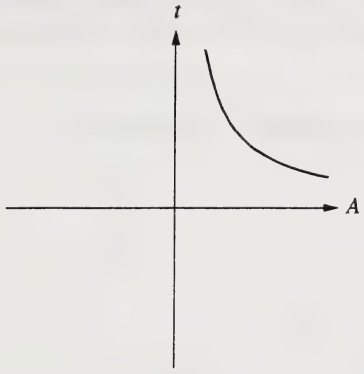
Possible Solution:

Aaron enters the parkade and automatically owes the attendant $1.00. If Aaron leaves the parkade before one hour elapses, the amount owing will still be $1.00. After one hour, Aaron's cost jumps to $2.00. Aaron owes $2.00 for any time between one and two hours. After two hours, Aaron's cost jumps to $3.00 and this appears to be the maximum cost that Aaron would pay no matter how long the car is parked.

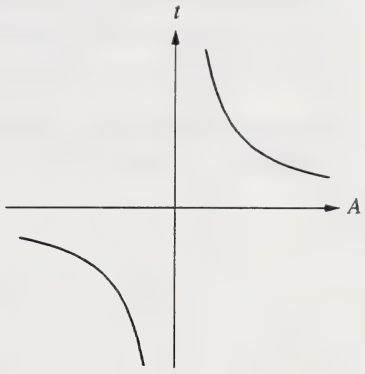
The student demonstrating excellent achievement can answer the following type of question.

2. The time t needed to fill a tank varies inversely with the cross-sectional area, A, of the hose. Aaron linked filling the gas tank of a car to one of the following graphs. Which graph **best** illustrates this relationship?

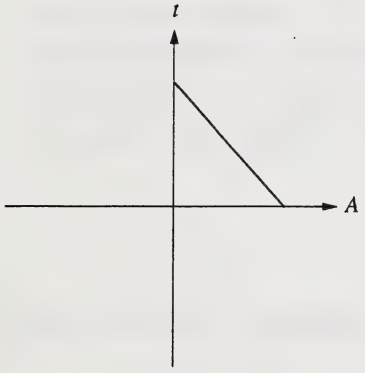
***A.**



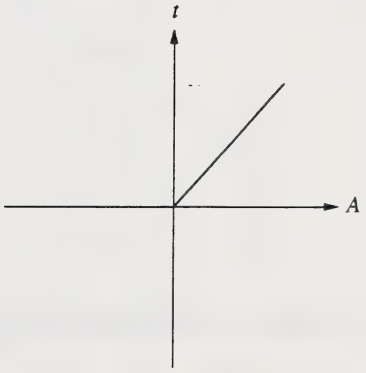
B.



C.



D.

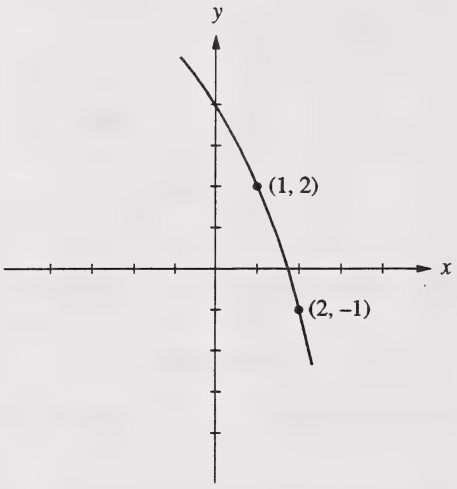


The following questions also illustrate standards from the Relations and Functions Unit but under the scenario of connections.

The student demonstrating acceptable achievement can answer the following types of questions.

SCENARIO: **CONNECTIONS**
Your understanding of the relationships among variables and equations can be connected to understanding of graphical representations in answering the next questions.

3. The graph of the function $y = f(x)$ is shown below. Two points on $y = f(x)$ are $(1, 2)$ and $(2, -1)$.



An ordered pair that represents a point on the graph of the inverse of this function is

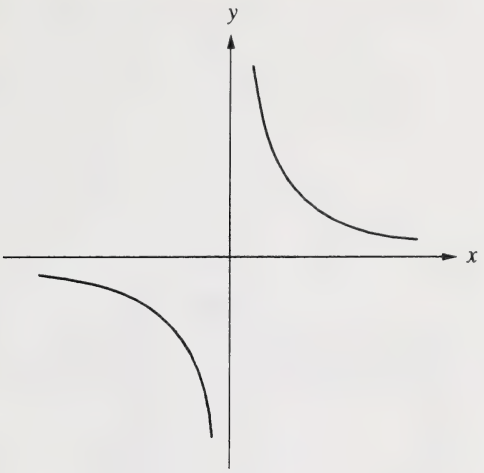
A. $\left(-1, \frac{1}{2}\right)$

* **B.** $(-1, 2)$

C. $(-2, 1)$

D. $\left(1, \frac{1}{2}\right)$

4. The graph of a function is shown below.



The function represented by the graph is

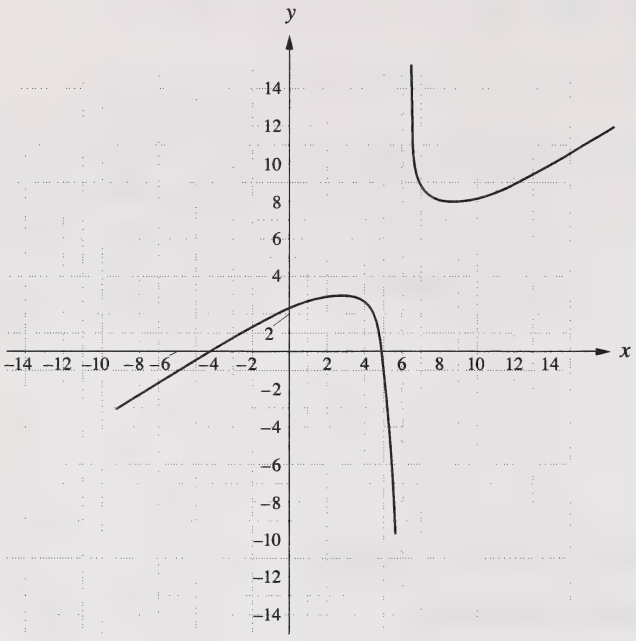
A. an exponential function

* **B.** a reciprocal function

C. a cubic function

D. an absolute value function

5. The graph of a function $y = f(x)$ is shown below.



The domain and range, respectively, of the function shown are

* **A.** $D = \{x \mid x \neq 6\}$
$R = \{y \mid y \leq 3 \text{ or } y \geq 8\}$

B. $D = \{y \mid y \neq 6\}$
$R = \{x \mid x \leq 3 \text{ or } y \geq 8\}$

C. $D = \{x \mid x \neq 6\}$
$R = \{y \mid y \in \text{Real numbers}\}$

D. $D = \{x \mid x \in \text{Real numbers}\}$
$R = \{y \mid y \in \text{Real numbers}\}$

The student demonstrating excellent achievement can answer the following types of questions.

6. The inverse function of $f(x) = 3x - 2$ is

* **A.** $f^{-1}(x) = \frac{x+2}{3}$

B. $f^{-1}(x) = \frac{1}{3}x - \frac{1}{2}$

C. $f^{-1}(x) = -3x + 2$

D. $f^{-1}(x) = x + 2$

Written Response

The function $f(x) = x^3$ is transformed so that a change in the parameters a, b, and c in $y = c \bullet f(x-a) + b$ cause it to become $f(x) = -1(x-3)^3 + 2$.

2. Describe in detail the effect of changing each parameter a, b, and c on the graph of $f(x) = x^3$.

Parameter a
Possible Solution: The parameter a shifts the graph to the right a units if a is positive and to the left a units if a is negative. In this case, the value of a causes the graph of $f(x) = x^3$ to be shifted right 3 units.

Parameter b
Possible Solution: The parameter b shifts the graph up b units if b is positive and down b units if b is negative. In this case, the value of b causes the graph of $f(x) = x^3$ to be shifted up 2 units.

Parameter c
Possible Solution: Having a negative value for c reflects the graph in the x-axis.

Quadratic Functions and Equations

Students who achieve the standards can demonstrate the following general outcome upon completion of the unit: *Connect variables and equations to graphical representations of quadratic functions that model real-world contexts.*

Illustration of the general outcome
Given any quadratic function, either directly or implied in a problem, and the equation of the function, students can determine the graph of the function and the roots of the corresponding equation **and** can describe, in writing, the relationship between the roots and the graph.

The student demonstrating acceptable achievement can:

- sketch the graphs of quadratic functions $y = a(x - h)^2 + k$, where h and k are integers, a is a rational number, and $a \neq 0$
- transform $y = ax^2 + bx + c$ to $y = a(x - h)^2 + k$, where h and k are integers and a is a rational number, $a \neq 0$
- given the graph or the equation of a quadratic function, determine its vertex, axis of symmetry, domain, range, maximum or minimum value of the function, and x- and y-intercepts
- given a real-world situation modelled by a quadratic function, place into the appropriate context the maximum or minimum values and the x- and y-intercepts
- solve quadratic equations whose solutions are elements of the real numbers
- determine whether or not a given quadratic equation describes a particular real-world situation
- recognize that there is a relationship between the x-intercepts of the graph of a quadratic function, the roots of its corresponding equation, and the zeros of the quadratic function
- solve a radical equation with no extraneous roots consisting of a single radical whose solutions are the roots of a quadratic equation
- solve an equation that includes two rational expressions with monomial denominators, whose solution(s) is/are the root(s) of a quadratic or a linear equation
- solve problems that involve equations with radicals or rational expressions, whose solutions are the roots of quadratic equations, when the radical or rational equation is given
- solve simple problems whose solutions are the roots of quadratic equations

- use the x-intercepts of a quadratic function, where $c = \pm 1$ in $c(x-a)(x-d)$, to determine a corresponding quadratic equation

The student demonstrating excellent achievement can:

- transform $y = ax^2 + bx + c$ to $y = a(x-h)^2 + k$, where h and k are rational and $a \neq 0$
- given any quadratic function, determine the vertex, axis of symmetry, domain, range, maximum or minimum value x- and y-intercepts, and its sketch
- derive a quadratic function that models a real-world situation and place into the appropriate context the maximum or minimum values and the x- and y-intercepts
- explain, orally or in writing, the relationship between the x-intercepts of the graph of a quadratic function, the roots of its corresponding equation, and the zeros of the quadratic function
- solve a radical equation that may have extraneous roots with two or more like radicals and whose solution is the root of a quadratic equation
- solve a rational expression equation whose solution is the root(s) of a quadratic or linear equation
- solve problems that involve equations with radicals or rational expressions whose solutions are the roots of quadratic equations

The student demonstrating acceptable achievement can answer the following types of questions.

SCENARIO: **CONNECTIONS**
Your understanding of the relationships between equations and graphs will be useful in solving the next set of questions.

Numerical Response

1. The smallest real number solution (to the nearest tenth) of the quadratic equation $2x^2 - 11x + 15 = 0$ is _____2.5_____ .

(Record your answer on the answer sheet.)

Solution:

$$\begin{aligned} 2x^2 - 11x + 15 &= 0 \\ (2x-5)(x-3) &= 0 \\ 2x - 5 = 0 \quad &\text{OR} \quad x - 3 = 0 \\ 2x = 5 \quad &\text{OR} \quad x = 3 \\ x = \frac{5}{2} \text{ or } 2.5 \quad &\text{OR} \quad x = 3 \end{aligned}$$

Therefore, the smallest real number solution rounded to the nearest tenth is **2.5**.

Numerical Response

2. For the equation $\sqrt{15x+1} - 3 = x$, the largest numerical solution is _____8.0_____.

(Record your answer on the answer sheet.)

Solution:

$$\begin{aligned} \sqrt{15x+1} &= x+3 \\ 15x+1 &= x^2+6x+9 \\ 0 &= x^2+6x-15x+9-1 \\ 0 &= x^2-9x+8 \\ 0 &= (x-8)(x-1) \\ x-8 = 0 \quad &\text{OR} \quad x-1 = 0 \\ x = 8 \quad &\text{OR} \quad x = 1 \end{aligned}$$

Therefore, the correct answer is 8.

Connect your ability to write a quadratic equation to answering the next question.

1. The floor in a warehouse is rectangular in shape and has an area of $28\ m^2$. The length is $3\ m$ longer than the width. If x represents the measure of the width, then an equation that could be used to find the measure of the width is

A. $x^2 - 25 = 0$

B. $4x^2 - 28 = 0$

* **C.** $x^2 + 3x - 28 = 0$

D. $x^2 + 3x + 28 = 0$

Quadratic functions are sometimes represented by graphs on a coordinate plane. Connecting your understanding of quadratic functions to their graphs will be helpful in answering the next three questions.

2. The equation of a quadratic function having a vertex at $(-1, 3)$ is

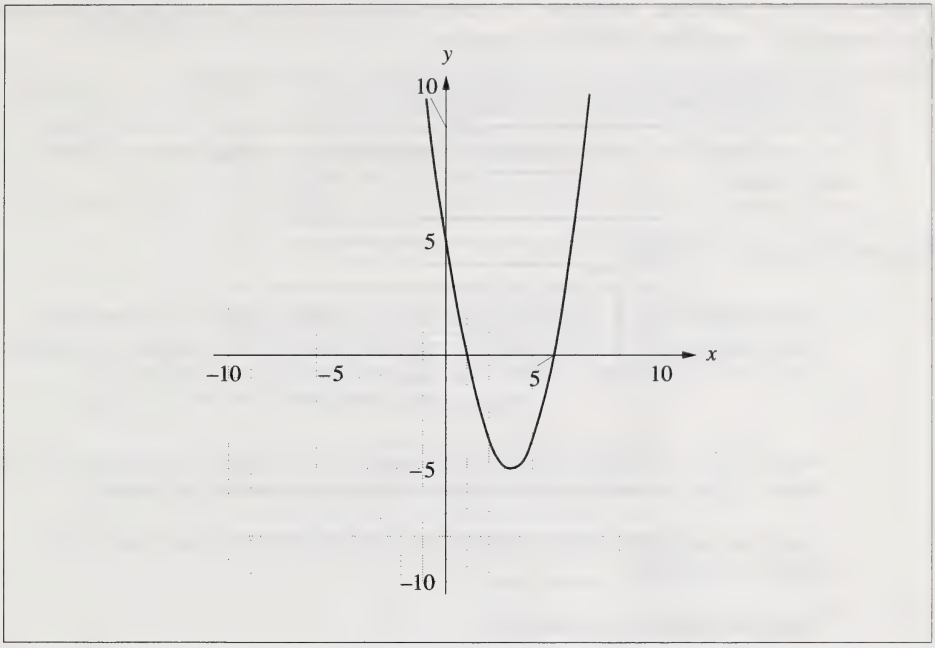
A. $y = (x - 1)^2 + 3$

B. $y = (x - 1)^2 - 3$

* **C.** $y = (x + 1)^2 + 3$

D. $y = (x + 1)^2 - 3$

Use the following graph to answer questions 3 and 4.



3. The graph above represents a quadratic function. The vertex of the graph is

A. (0, 4)
B. (5.5, 0)
C. (–5, 3)
* **D.** (3, –5)

4. The minimum/maximum value of the function represented by the graph above is a

* **A.** minimum of –5
B. maximum of –5
C. minimum of 3
D. maximum of 3

The student demonstrating acceptable achievement can successfully complete part of the following question, whereas the student demonstrating excellent achievement can successfully complete all of this question.

SCENARIO: **SPORTS AND RECREATION**
In a math project, Bobbie connected understanding of quadratics to diving and football.

Written Response – 4 marks

1. **a.** When Bobbie dove from the spring diving board at the local swimming pool, the path of the dive could be approximated by the quadratic function

$$H(t) = -5(t - 1)^2 + 6$$

where H is the height of Bobbie's toes above the water in metres and t is the time elapsed in seconds after Bobbie's toes leave the diving board.

Find the maximum height Bobbie's toes reach and the time at which this height is reached.

Possible Solution: (2 marks)

Maximum height of Bobbie's toes occurs at the vertex $(1, 6)$.

From the vertex, the height is 6 m when the time (t) is 1 second.

OR

Bobbie's toes reached maximum height of 6 m when the time was 1 second.

b. Find the height of the diving board.

Possible Solution: (2 marks)

The height of a diving board corresponds to the point where no time has elapsed, so set $t = 0$.

$$\begin{aligned} H(0) &= -5(0 - 1)^2 + 6 \\ &= -5(1) + 6 \\ &= 1 \end{aligned}$$

The height of the diving board is approximately 1 metre.

c. Find the elapsed time after which Bobbie's toes touched the water.

Possible Solution: (2 marks)

The time that Bobbie's toes enter the water corresponds to the point at which height = 0. So, set $H = 0$ and solve for t.

$$\begin{aligned} -5(t-1)^2 + 6 &= 0 \\ -5(t^2 - 2t + 1) + 6 &= 0 \\ -5t^2 + 10t - 5 + 6 &= 0 \\ -5t^2 + 10t + 1 &= 0 \\ t &= -0.1 \text{ or } 2.1 \end{aligned}$$

Neglecting the negative time, Bobbie's toes touched the water at approximately 2.1 seconds.

The student demonstrating excellent achievement can answer the following types of questions.

5. A football is kicked upward and travels in a parabolic path. At the instant the football reaches the path's maximum height of 25 m, the ball has travelled a horizontal distance of 50 m. A **possible** function for the path relating height, h, to a horizontal distance, x, is

A. $h(x) = 5(x - 25)^2 + 50$

B. $h(x) = -5(x - 25)^2 + 25$

C. $h(x) = -5(x - 25)^2 + 50$

* **D.** $h(x) = -5(x - 50)^2 + 25$

In math class, Bobbie had to explain the relationship between a quadratic function and a quadratic equation.

Written Response – 4 marks

2. Show that the solution of the quadratic equation $x^2 + 5x = 6$ is numerically identical to the x-intercept(s) of the graph of the quadratic function $y = x^2 + 5x - 6$, and explain **why** they are the same.

First part of solution: (to the quadratic equation)
The quadratic equation $x^2 + 5x = 6$ may be rewritten as

$$x^2 + 5x - 6 = 0$$
$$(x + 6)(x - 1) = 0$$
$$x + 6 = 0 \quad \text{or} \quad x - 1 = 0$$
$$\text{So, } x = -6 \quad \text{or} \quad x = 1$$

Second part of solution: (x-intercepts of the graph of the quadratic function)
In the quadratic function $y = x^2 + 5x - 6$, the x-intercepts of the function occur at points where the graph crosses or touches the x-axis and $\therefore$ $y = 0$ at these points.

So: set $y = 0$.
This results in the quadratic equation $0 = x^2 + 5x - 6$, which is the same equation as in the first part above and $\therefore$ has the same solutions.
$\therefore$ the x-intercepts of the function $y = x^2 + 5x - 6$ are -6 and 1, which correspond to the roots of the quadratic equation $x^2 + 5x - 6 = 0$.

Powers and Radicals

Students who achieve the standards can demonstrate the following general outcome upon completion of the unit: *Determine equivalent forms of radical expressions. Solve and verify radical equations.*

Illustration of the general outcome
Show that mathematical operations on radicals are similar to the mathematical operations on polynomials.

The student demonstrating acceptable achievement can:

- perform the operations of addition, subtraction, multiplication, and division on second-order radicals with monomial demoninators and numerical radicands, and show that these operations are a specific instance of the operations on polynomials
- change second-order radicals from mixed to entire form and vice-versa
- solve second-order radical equations

The student demonstrating excellent achievement can:

- change third-order radicals from mixed to entire form and vice-versa
- solve second-order radical equations whose solutions involve the simplification of a quadratic equation
- solve problems involving radical equations

The student demonstrating acceptable achievement can answer the following types of questions.

SCENARIO: **CAREER APPLICATIONS**
Part of Dali's on-the-job training with Transworld Utilities involved the review of radicals. Transworld Utilities supplies electrical power, and employees are asked to solve problems that often involve radicals. Help Dali by answering the following questions.

1. The correct simplified version of the expression $3\sqrt{5} + 7\sqrt{2} - 5\sqrt{5} + 2\sqrt{2}$ is

A. $8\sqrt{52} + 9\sqrt{2}$

B. $-17\sqrt{10}$

* **C.** $-2\sqrt{5} + 9\sqrt{2}$

D. $7\sqrt{10}$

2. An equivalent form of the expression $3\sqrt{98}$ is

A. $10\sqrt{2}$

* **B.** $21\sqrt{2}$

C. $6\sqrt{49}$

D. $5\sqrt{49}$

Before accepting the job and training at Transworld Utilities, Dali applied to a police force and was given the following problem to solve.

Numerical Response

1. At the scene of an accident, police measure the approximate speed that a vehicle was travelling by measuring the length of the skid marks left on the pavement. One formula used for this purpose is $v = 14.9\sqrt{L} - 20.4$, where v represents the speed of the vehicle, and L represents the length of the skid marks in metres. A vehicle is travelling on a road at 55 km/h and brakes so that it skids to a stop. The length of the skid mark (to one decimal place) that the vehicle will leave on the road is __25.6__ m.

(Record your answer on the answer sheet.)

Solution:

$$55 = 14.9\sqrt{L} - 20.4$$

$$75.4 = 14.9\sqrt{L}$$

$$\frac{75.4}{14.9} = \sqrt{L}$$

$$25.6 = L$$

The length of the skid mark, to one decimal place, is 25.6 metres.

The student demonstrating excellent achievement can answer the following types of questions.

Numerical Response

2. The largest root of the equation $\sqrt{x}+4=x-8$ is ____16____.

(Record your answer on the answer sheet.)

Solution:

$$\sqrt{x}+4 = x-8$$
$$\sqrt{x} = x-12$$
$$\left(\sqrt{x}\right)^2 = (x-12)^2$$
$$x = x^2-24x+144$$
$$0 = x^2-25x+144$$
$$0 = (x-9)(x-16)$$
$$x = 9 \quad \text{OR} \quad x=16$$

$x = 9$ is not a solution.

The largest root is 16.

3. The radical $2\sqrt[3]{5}$ is equivalent to

A. $\sqrt[3]{10}$

B. $\sqrt[3]{25}$

C. $\sqrt[3]{32}$

* **D.** $\sqrt[3]{40}$

Polynomials and Rational Expressions

Students who achieve the standards can demonstrate the following general outcome upon completion of the unit: *Show how the operations on rational numbers can be extended to rational expressions and the applications of rational expressions.*

Illustration of the general outcome
Show that the operations on rational expressions are a generalization of the operations on rational numbers.

The student demonstrating acceptable achievement can:

- recognize and give examples of rational expressions
- determine the real non-permissible values of a variable in a rational expression with its denominator in the form of a monomial, binomial, or trinomial of the form $x^2 + bx + c$ or with its denominator in factored form
- recognize and give examples of rational expressions where there are no real non-permissible values for the variable
- simplify rational expressions that contain monomials, binomials, or trinomials in the form $ax^2 + bx + c$ but that do not contain factors of -1
- multiply or divide two rational expressions that contain monomials, binomials, or trinomials in the form $ax^2 + bx + c$
- add or subtract two rational expressions with non-factorable binomial denominators
- solve equations involving rational expressions with non-factorable denominators
- solve problems involving rational expressions given the equation

The student demonstrating excellent achievement can:

- determine the real non-permissible values of a variable in any rational expression
- describe the relationship between non-permissible values of a rational expression and the graph of the rational function (and how this relates to the reciprocal function studied in relations and functions)
- simplify rational expressions that do contain factors of -1
- multiply or divide two or more rational expressions
- add or subtract two rational expressions
- solve equations involving rational expressions with factorable denominators
- solve problems involving equations containing rational expressions

The student demonstrating acceptable achievement can answer the following types of questions.

SCENARIO: **CONNECTIONS**
Kelly solved the following questions by connecting factoring, equation-solving skills, and operations on fractions to rational expressions and equations.

Numerical Response

1. The largest non-permissible value of x for the rational expression $\frac{x+4}{x^2+x-6}$ is _____2_____.
(Record your answer on the answer sheet.)

1. A simplified form of $\frac{1}{m-1} + \frac{m+1}{2(m-1)}$ is

A. $\frac{m+3}{2}$

B. $\frac{m+2}{2(m-1)}$, $m \neq 1$

* **C.** $\frac{m+3}{2(m-1)}$, $m \neq 1$

D. $\frac{2m+3}{2}$

The student demonstrating excellent achievement can answer the following types of questions.

2. A simplified form of $\frac{x+y}{y-x} \div \frac{1}{x-y}$ is

A. $-x+y,\ x \neq y$

B. $x+y,\ x-y \neq 0$

* **C.** $-x-y,\ y-x \neq 0$

D. $x-y,\ y \neq x$

3. When fully simplified, $\frac{2x}{x^2-4} + \frac{x-2}{x^2-4x+4}$ is equal to

* **A.** $\frac{3x+2}{(x-2)(x+2)},\ x \neq \pm 2$

B. $\frac{2x}{(x-2)(x+2)},\ x \neq \pm 2$

C. $\frac{x^2+2x-4}{(x-2)(x+2)},\ x \neq \pm 2$

D. $\frac{2x+1}{(x-2)(x+2)},\ x \neq \pm 2$

Written Response – 4 marks

1. A small plane and a transport truck travel 300 km from Calgary to Edmonton. The truck travels 50 km/h slower than the small plane. The truck takes 1 hour longer to travel the same distance. Calculate the current speed of the small plane, given Kelly's partial solution.

Kelly's Partial Solution: Let s = the speed of the small plane.

	Distance	Speed	Time
Small plane	300	s	$\frac{300}{s}$
Truck	300	$s - 50$	$\frac{300}{s-50}$

Time for transport truck – Time for small plane = 1

Completed Solution:

$$\frac{300}{s-50} - \frac{300}{s} = 1$$

$$300s - 300s + 15\,000 = 1(s)(s-50)$$

$$0 = s^2 - 50s - 15\,000$$

$$0 = (s+100)(s-150)$$

$$\therefore s + 100 = 0 \quad \text{OR} \quad s - 150 = 0$$

$$s = -100 \quad \text{OR} \quad s = 150$$

Neglecting the negative value, the current speed of the small plane is 150 km/h.

Trigonometry

Students who achieve the standards can demonstrate the following general outcome upon completion of the unit:
Solve problems that involve triangles and their applications.

Illustrations of the general outcome
Extend right angle trigonometry to angles in a coordinate plane.

Use understanding of sine and cosine law to solve oblique triangles.

The student demonstrating acceptable achievement can:

- recognize and give examples of the principal and other co-terminal angles for angles drawn in standard position on a coordinate plane
- determine the measure of the reference angle for any angle in standard position on a coordinate plane
- determine the sine, cosine, and tangent ratios, and the measure of the principal angle for coordinates of any point with numerical coordinates on the terminal arm of an angle in standard position
- determine the sine, cosine, and tangent ratios for any angle measure
- recognize the graph of $y = \sin\theta$
- use the graph of $y = \sin\theta$ to solve trigonometric equations
- describe, orally or in writing, the effects of changing either of the parameters a or b on the graph of the function $y = a \sin b\theta$
- determine the measures of sides and angles in problems that involve two right triangles if a diagram is given
- decide whether or not the information provided for a triangle uniquely defines an oblique triangle, and if it does not, construct the possible triangles
- determine the missing measures of sides and angles in problems that involve oblique triangles if a diagram is given
- determine the missing measures of sides and angles in problems that involve a uniquely defined oblique triangle if a diagram is given

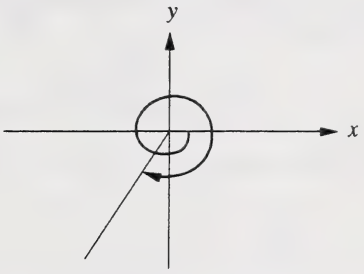
The student demonstrating excellent achievement can:

- determine an expression for any angle that will yield all its possible co-terminal angles
- determine the sine, cosine, and tangent ratios of an angle in standard position given the coordinates of any point, including points with literal coordinates, on its terminal arm
- determine any two of the x-coordinate of a point on the terminal arm of an angle in standard position, the y-coordinate of a point on the terminal arm of an angle in standard position, the measure of the angle, and the distance that the point lies from the origin, given the other two
- determine the measures of all angles between $0°$ and $360°$ that satisfy a given sine, cosine, or tangent ratio
- describe, orally or in writing, the effects of changing both a and b on the graph of the function $y = a \sin b\theta$
- determine the measures of sides and angles in problems that involve right triangles in two dimensions
- given the diagram of three-dimensional objects composed of two or more right triangles, determine the missing measures of sides and angles of the triangles
- determine the missing measures of sides and angles in problems that involve oblique triangles

The student demonstrating acceptable achievement can answer the following types of questions.

SCENARIO: **CONNECTIONS**
Use your understanding that angles and functions can be drawn on a coordinate plane to answer the next questions.

1. An angle in standard position is shown below.



The measure of the principal angle could be

* **A.** 220°

B. −140°

C. 140°

D. −580°

2. If $\tan\theta = -\frac{5}{12}$ and $0° < \theta < 180°$, then $\sin\theta$ equals

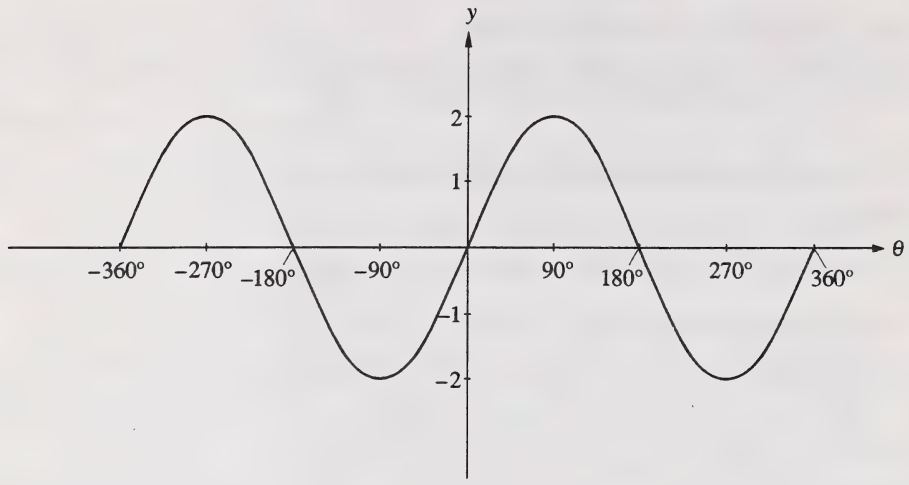
* **A.** $\frac{5}{13}$

B. $\frac{13}{12}$

C. $\frac{12}{13}$

D. $\frac{5}{17}$

3. Dale was graphing the sine function $y = a \sin b\theta$ for selected values of a and b on the computer and obtained the graph shown below.



In order to double the amplitude of this graph, Dale should

* **A.** double the value of a

B. double the value of b

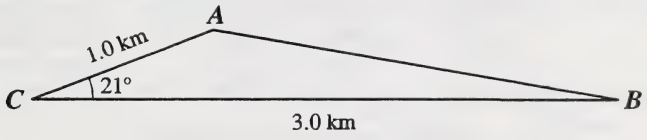
C. halve the value of a

D. halve the value of b

SCENARIO: **ALBERTA INDUSTRIES**
A surveyor for an Alberta industry used aerial photographs and diagrams to solve the following problems.

Written Response – 3 marks

1. The diagram below shows measurements between towns A, B, and C. The distance between Town A and Town C is 1.0 km. The distance between Town C and Town B is 3.0 km and the measure of $\angle ACB$ is 21°.



Find the distance from Town A to Town B to the nearest tenth of a kilometre.

Solution:

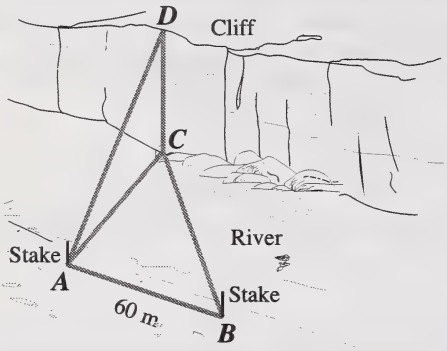
$$\begin{aligned} c^2 &= a^2 + b^2 - 2ab\cos C \\ &= 3^2 + 1^2 - 2(3)(1)(\cos 21°) \\ &= 9 + 1 - 5.6015 \\ c &= 2.1 \text{ km} \end{aligned}$$

The distance is 2.1 km.

The student demonstrating excellent achievement can answer the following types of questions.

Written Response – 4 marks

The surveyor drew the following diagram, which shows the measurements used to find the height of a cliff.



Note: $\angle DAC = 20°$
$\angle ABC = 40°$
$\angle ACD = 90°$
$\angle CAB = 90°$
$\overline{AB} = 60\text{m}$

2. Determine the height $\overline{DC}$ of the cliff to the nearest tenth of a metre.

Possible Solution:

The surveyor can use two right triangles ΔABC and ΔACD to solve this problem. The distance across the river, $\overline{AC}$, can be found by:

$$\tan 40° = \frac{\overline{AC}}{60}$$

$$60 \tan 40° = \overline{AC}$$

$$\overline{AC} = 50.3$$

Use ΔABC and the distance across the river, $\overline{AC}$, to find the height of the cliff, $\overline{DC}$.

$$\tan 20° = \frac{\overline{DC}}{50.3}$$

$$\overline{DC} = 50.3 \tan 20°$$

$$\overline{DC} = 18.3$$

The height of the cliff is 18.3 m.

Statistics

Students who achieve the standards can demonstrate the following general outcome upon completion of the unit: *Collect, organize, analyze and draw inferences from bivariate data and from data obtained through "yes/no" surveys.*

Illustration of the general outcome
Given a problem whose solution requires the use of statistics, students should be able to design and administer surveys, collect and organize the results of surveys, draw inferences from surveys including bivariate data and yes/no questions, and determine the confidence intervals for the results of yes/no surveys.

The student demonstrating acceptable achievement can:

- collect and plot bivariate data
- design and administer surveys, collect and organize results, and draw inferences from surveys including bivariate data and yes/no questions
- assess the strengths, weaknesses, and biases of samples
- recognize and describe the apparent correlation between the variables of a bivariate distribution from a scatter plot
- draw 50% and 90% box plots of the results of multiple samples
- plot a line of best fit on a scatter plot using the median fit method
- use charts of 90% box plots to determine the confidence interval of the proportion of yeses in the population
- illustrate the steps or strategies that lead to the solution of problems that require the analysis of statistics studied in Mathematics 33

The student demonstrating excellent achievement can:

- describe, orally or in writing, what is meant by the confidence interval for the proportion of yeses in the population
- develop and use prediction equations for a line of best fit to make inferences for populations
- complete the solution to problems that require the analysis of statistics studied in Mathematics 33

The student demonstrating acceptable achievement can answer the following types of questions.

SCENARIO: **SPORTS AND RECREATION**
Management decisions related to running a sports franchise are often linked to statistics. In the next question, the management would like you to draw an inference about the percentage of patrons who will buy hot dogs.

Numerical Response

1. Out of a sample of 20 randomly selected patrons at a baseball stadium, 8 bought a hot dog during the game. Based on this sample and using a 90% box plot, the percentage of all patrons at the baseball stadium buying a hot dog is between 25% and ____60____ %.

(Record your answer on the answer sheet.)

For broadcast purposes, the management would like you to analyze the number of calls to be routed through Alberta.

1. To relay the results of a ball game, 40 phone calls were placed from Nova Scotia to British Columbia. Thirty-two of these phone calls were routed through telecommunication networks in Alberta. Using a 90% box plot, one could determine that 70% to 85% of all phone calls between Nova Scotia and British Columbia are routed through Alberta.

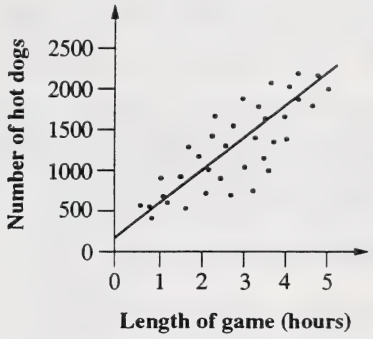
   If 120 phone calls are placed between Nova Scotia and British Columbia to relay ball game results, then the number of calls that would likely be routed through Alberta is between

   * **A.** 84 and 102
   B. 70 and 85
   C. 60 and 75
   D. 50 and 85

The student demonstrating excellent achievement can answer the following types of questions.

Use the following information to answer the next question.

The scatter plot below shows the relationship between the length of baseball games and the number of hot dogs sold.



Written Response – 4 marks

1. **a.** If (1, 600) and (4, 1800) are two points on the line of **best** fit, then determine the equation of the line of best fit. Use the letter n to represent the number of hot dogs sold and the letter l to represent the length of the game.

Possible Solution:

Note: The slope y-intercept form of a line is $y = mx + b$. To determine the slope (m) and the y-intercept (b) of the line of best fit, start with $n = ml + b$ and build a system of equations.

$$\begin{array}{lrcll} & n & = & ml + b & & \\ \text{For 4 hours:} & 1\,800 & = & m(4) + b & \rightarrow & 1\,800 = 4m + b \\ \text{For 1 hour:} & 600 & = & m(1) + b & \rightarrow & \underline{600 = m + b} \\ & & & & & \frac{1\,200}{3} = \frac{3}{3}m \\ & & & & & 400 = m \\ & & & & & \therefore\ b = 200 \end{array}$$

Since the slope is 400 and the y-intercept is 200, the equation is $n = 400\,l + 200$, where n is the number of hot dogs sold and l is the length of the game in hours.

b. Use the equation that you wrote in part **a** to explain how increasing the length of the game correlates to the number of hot dogs sold.

Possible Solution:
Increasing the length of the game increases the number of hot dogs sold. This is consistent with increasing the value of l in the equation $n = 400l + 200$. As you increase the value of l, the value of n (number of hot dogs sold) increases.

Numerical Response

2. On another day in another stadium, the line of best fit for a scatter plot was determined to be $n = 300\,l + 150$, where n is the number of hot dogs sold and l is the length of the game in hours. For a two-hour game, the number of hot dogs the stadium should expect to sell is _____750_____ .

(Record your answer on the answer sheet.)

Annuities, Mortgages, and Loans

Students who achieve the standards can demonstrate the following general outcome upon completion of the unit: *Apply the concepts of ratio, rate, percentage, and proportion to annuities, loans, and mortgages.*

Illustration of the general outcome
Extend understanding of rate, ratios, percentage, and proportion to solve real-world problems related to annuities, mortgages, and loans.

The student demonstrating acceptable achievement can:
- recognize that an annuity is a sequence of payments paid in regular intervals for purposes of investment or income
- recognize that a loan is a sum of money that is borrowed to purchase items and is usually repaid in a sequence of payments
- recognize that a mortgage is a special type of loan used to purchase real estate
- given the principal, interest rate, and term, determine the monthly payment for a loan or mortgage
- solve problems that are clearly identified as mortgage, loan, or annuity problems
- given the periodic payment, interest rate, and term, determine the amount of an annuity
- given the periodic payment, number of payments, and interest rate, determine the present value of an annuity
- show that the amount or present value of an annuity is determined by multiplying the amount of a regular payment by a value in a table
- show how the amount or present value of an annuity can be determined using a calculator or spreadsheet

The student demonstrating excellent achievement can:
- given a situation, identify the situation as a present value of an annuity or an amount of an annuity and then solve a related problem
- given the principal, interest rate, and term, find the monthly payment of a loan or mortgage and the interest or the total amount to be repaid
- given a situation, identify it as a situation where a loan, annuity, or mortage would be necessary, and solve the related problem
- given the total amount of an annuity, the interest rate, and term, determine the periodic payment
- given the present value of an annuity, number of payments, and interest rate, determine the periodic payments

The following are examples of questions requiring the use of the Annuity and Present Value of an Annuity tables contained in the Data Booklet (Appendix E).

Amount of an Annuity

The amount of the annuity (A) = the amount of a regular payment (R) $\times$ value read from the table ($s_{\overline{n}|i}$), where n is the number of payments and i is the interest rate per period.

Example 1

Determine the amount of an annuity for regular yearly payments of \$50 for 4 years at 6% per annum compounded yearly.

Solution:

Since this is an annuity question, find the amount of the annuity by multiplying the amount of a regular payment by the value ($s_{\overline{n}|i}$) found in the tables.

The amount of the regular payment (R) = 50

Number of payments (n) is 4

Interest per period (i) is 6%

Therefore, from the tables $S_{\overline{n}|i}$ = 4.63709

Since the amount of the annuity is $Rs_{\overline{n}|i}$

= 50(4.63709)

= 231.85

The amount of the annuity is \$231.85.

Example 2

Determine the monthly payments required to produce \$5 000 in 3 years if interest is at 12% per annum.

Solution:

Since this is an annuity question, find the regular payment by dividing the amount of the annuity (A) by the value found in the table ($s_{\overline{n}|i}$).

The amount of the annuity is 5 000

Number of payments (n) $= (3 \times 12) = 36$

Interest per period (i) $= \frac{12\%}{12} = 1\%$

Therefore, from the tables $S_{\overline{n}|i} = 43.50765$

The amount of the annuity is $Rs_{\overline{n}|i}$

Therefore, $5\,000 = R(43.50765)$

$$R = \frac{5\,000}{43.50765}$$

$$= 114.92$$

The monthly payments on this annuity will be \$114.92.

Present Value of an Annuity Formula

The present value of an annuity is the amount of a regular payment (R) $\times$ the value found in the table ($a_{\overline{n}|i}$), where,

n is the number of payments and
i is the interest rate per period.

Example 1

Chris overspent on a charge card account and cut up the card to avoid future debits. Chris must pay \$75 at the end of each month for the next 3 years to settle the debt. If the interest rate is 18% per annum compounded monthly, what is the amount now owing on his account?

Solution:

Since this question asks for the value of the account owing now from a loan, we consider this as a present value question. The present value can be determined by multiplying the amount of a regular payment by the value found in the tables ($a_{\overline{n}|i}$).

Number of payments (n) $= (3 \times 12) = 36$

Interest per period (i) $= \frac{18\%}{12} = 1\frac{1}{2}\%$

Therefore, from the tables $a_{\overline{n}|i} = 27.66068$

The present value is $Ra_{\overline{n}|i}$

Therefore, present value $= 75(27.66068)$
$= 2\,074.55$

The balance owing on the charge card account is \$2 074.55.

Example 2

Determine the regular semi-annual payments that you would receive from an investment of \$20 000, if it is invested in an annuity paying 8% per annum compounded semi-annually for 10 years.

Solution:

This question indicates that you will be receiving regular payments from the \$20 000 that you invest now; therefore, this is a present value question.
The present value is $Ra_{\overline{n}|i}$, where the present value is 20 000, and **R** = ?

Number of payments = (10×2) 20

Interest per period = $\frac{8\%}{2}$ = 4%

Therefore, from the tables $a_{\overline{n}|i}$ = 13.59033

The present value is $Ra_{\overline{n}|i}$

Therefore, 20 000 = R(13.59033)

$$R = \frac{20\,000}{13.59033}$$

= 1 471.63

The investment will pay regular semi-annual payments of \$1 471.63.

The student demonstrating acceptable achievement can answer the following types of questions.

SCENARIO: **CONSUMERISM**
Kelly, a recent Mathematics 33 graduate, is able to use understanding of annuities, mortages, and loans to determine the answers to many consumer questions. Use your understanding of this area to answer the questions that follow.

1. A mortgage is **best** described as

* **A.** money that is borrowed to purchase real estate
B. funds that are borrowed to purchase items
C. a sequence of payments you receive at regular intervals
D. an amount paid at each interval

Explanation:

Mortgages are used to purchase homes and large investments, therefore, **A.** is the **best** response.

Kelly decides to save for a new car and would like to determine the total amount that could be saved in 3 years in an annuity.

2. At the beginning of each month, Kelly deposits \$200 in an account that bears interest at 6% per annum compounded monthly. How much money will Kelly have at the end of 3 years?

A. \$7 848.92
* **B.** \$7 906.56
C. \$8 701.53
D. \$12 148.63

Explanation:

Since this is an amount of an annuity question, the amount of an annuity is $Rs_{\overline{n}|i}$, where the amount of the annuity is unknown and $R = 200$

Number of payments $= (3 \times 12) = 36$

Interest per period $= \frac{6\%}{12} = \frac{1}{2}\%$

From the "Amount of an Annuity Table $s_{\overline{n}|i} = 39.53279$

The amount of the annuity is $Rs_{\overline{n}|i}$

Therefore, the amount $= 200(39.53279)$
$= 7\,906.56$

Kelly will have \$7 906.56 in the account at the end of 3 years; therefore, choice **B** is the correct response.

SPECIAL NOTE:
The course of studies recommends that students approach the problems involving annuities using **tables** and **spreadsheets**, as opposed to using the sum of a geometric series.

Kelly's friend Allyson takes out a loan that has a present value of $10 000 to put toward the purchase of a new automobile.

3. If Allyson's loan is for a 3-year term at an interest rate of 12% per annum compounded monthly, she will repay the loan in equal monthly payments of

A. $163.34
B. $208.33
* **C.** $332.14
D. $833.33

Explanation

The present value of the debt is $10 000; therefore, this is a present value question. The present value is $PV = Ra_{\overline{n}|i}$, where the present value is 10 000 and $R = ?$

Number of payments $= (3 \times 12) = 36$

Interest per period $= \frac{12\%}{12} = 1\%$

Therefore, from the tables $a_{\overline{n}|i} = 30.10751$

The present value is $Ra_{\overline{n}|i}$

Therefore, $10\,000 = R(30.10751)$

$$R = \frac{10\,000}{30.10751} = 332.14$$

Allyson's monthly payments will be $332.14; therefore, choice **C** is the correct response.

The student demonstrating excellent achievement can answer the following types of questions.

> *Allyson determined the annual payment required for an annuity to amount to $20 000.*

1. Determine the amount of the annual payment that Allyson needs to make at the beginning of each year for 25 years at 10%/a compounded annually that will amount to $20 000 at the end of the 25th year.

Solution:

Since this is an amount of an annuity question, where the amount of the annuity is $Rs_{\overline{n}|i}$. The amount of the annuity is 20 000.

The number of periods = $(1 \times 25) = 25$

Interest per payment = 10%

Therefore, from the Amount of an Annuity table

$$s_{\overline{n}|i} = 108.18177$$

The amount of the annuity is $Rs_{\overline{n}|i}$

Therefore, $20\,000 = R(108.18177)$

$$R = \frac{20\,000}{108.18177} = 184.87$$

The annual payment is $184.87.

Kelly received a retirement package of \$10 000, and used it to purchase an annuity.

2. Kelly purchased an annuity that paid a fixed amount at the end of every month for 3 years. If interest rates are 12% per annum, compounded monthly, how much will Kelly receive every month?

Solution:

Kelly is collecting from an investment where the present value of the investment is \$10 000. You need to determine how much Kelly will pay now; therefore, this is a present value question. The present value is $Ra_{\overline{n}|i}$, where the present value is 10 000 and $R =$ _____.

Number of payments = (3×12) = 36

Interest per period $= \frac{12\%}{12}$ = 1%

Therefore, from the tables $a_{\overline{n}|i}$ = 30.10751

The present value is $Ra_{\overline{n}|i}$

Therefore, 10 000 = R(30.10751)

$$R = \frac{10\,000}{30.10751} = 332.14$$

Kelly will receive \$332.14 monthly for three years from an initial investment of \$10 000.

Appendix C

Explanation of Mathematical Understandings

Procedures

The assessment of students' knowledge of *mathematical procedures* should provide evidence that they can:

- recognize when a procedure is appropriate
- give reasons for the steps in a procedure
- reliably and efficiently execute procedures
- verify the results of procedures empirically (e.g., using models) or analytically
- recognize correct and incorrect procedures
- generate new procedures and extend or modify familiar ones
- appreciate the nature and role of procedures in mathematics

It is important that students know how to execute mathematical procedures reliably and efficiently; a knowledge of procedures involves much more than simple execution. Students must know when to apply them, why they work, and how to verify that they have given a correct answer; they also must understand concepts underlying a procedure and the logic that justifies it. Procedural knowledge also involves the ability to differentiate those procedures that work from those that do not and the ability to modify them or create new ones. Students must be encouraged to appreciate the nature and role of procedures in mathematics; that is, they should appreciate that procedures are created or generated as tools to meet specific needs in an efficient manner and thus can be extended or modified to fit new situations. The assessment of students' procedural knowledge, therefore, should not be limited to an evaluation of their facility in performing procedures: it should emphasize all the aspects of procedural knowledge addressed in this standard.

Concepts

The assessment of students' knowledge and understanding of *mathematical concepts* should provide evidence that they can:

- label, verbalize, and define concepts
- identify and generate examples and non-examples
- use models, diagrams, and symbols to represent concepts
- translate from one mode of representation to another
- recognize the various meanings and interpretations of concepts
- identify properties of a given concept and recognize conditions that determine a particular concept
- compare and contrast concepts

In addition, assessment should provide evidence of the extent to which students have integrated their knowledge of various concepts.

An understanding of mathematical concepts involves more than mere recall of definitions and recognition of common examples; it encompasses the broad range of abilities identified in this standard. Assessment, too, must address these aspects of conceptual understanding. Assessment tasks should focus on students' abilities to discriminate between the relevant and the irrelevant attributes of a concept in selecting examples and non-examples, to represent concepts in various ways, and to recognize students' various meanings. Tasks that ask students to apply information about a given concept in novel situations provide strong evidence of students' knowledge and understanding of that concept. Problems designed to elicit information about students' misconceptions can provide information useful in planning or modifying instruction.

Problem Solving

The assessment of students' ability to use mathematics in *solving problems* should provide evidence that they can:

- formulate problems
- apply a variety of strategies to solve problems
- solve problems
- verify and interpret results
- generalize solutions

Students' ability to solve problems develops over time as a result of extended instruction, opportunities to solve many kinds of problems, and encounters with real-world situations. Students' progress should be assessed systematically, deliberately, and continually to effectively influence their confidence and ability to solve problems in various contexts. Assessments should determine students' ability to perform all aspects of problem solving. Evidence about their ability to ask questions, use given information, and make conjectures is essential to determine if they can formulate problems. Assessments also should yield evidence of students' use of strategies and problem-solving techniques and of their ability to verify and interpret results. Finally, because the power of mathematics is derived, in part, from its generalizability, this aspect of problem solving should be assessed as well.

From *Curriculum and Evaluation Standards for School Mathematics*, National Council of Teachers of Mathematics, 1989, p. 209, p. 223, p. 228.

Appendix D

Directing words

Compare
Show the character or relative values of two things by pointing out their *similarities* and *differences*

Conclude
State a logical end based on reasoning and/or evidence

Contrast/Distinguish
Point out the *differences* between two things that have similar or comparable natures

Criticize
Point out the *merits* and *demerits* of an item or issue

Define
Provide the essential qualities or meaning of a word or concept; make distinct and clear by marking out the limits

Describe
Give a written account or represent the characteristics of something by a figure, model, or picture

Design/Plan
Construct a plan, i.e, a detailed sequence of actions, for a specific purpose

Enumerate
Specify one by one or list in concise form and according to some order

Evaluate
Give the significance or worth of something by identifying the good and bad points or the advantages and disadvantages

Explain
Make clear what is not immediately obvious or entirely known; give the cause of or reason for; make known in detail

How
Show in what manner or way, with what meaning

Hypothesize
Form a tentative proposition intended as a possible explanation for an observed phenomenon; i.e., a possible cause for a specific effect. The proposition should be testable logically and/or empirically

Identify
Recognize and select as having the characteristics of something

Illustrate
Make clear by giving an example. The form of the example must be specified in the question; i.e., word description, sketch, or diagram

Infer
Form a generalization from sample data; arrive at a conclusion by reasoning from evidence

Interpret
Tell the meaning of something; present information in a new form that adds meaning to the original data

Justify/Show How
Show reasons for or give facts that support a position

Outline
Give, in an organized fashion, the essential parts of something. The form of the outline must be specified in the question; i.e., lists, flow charts, concept maps

Predict
Tell in advance on the basis of empirical evidence and/or logic

Prove
Establish the truth, validity, or genuineness of something by giving factual evidence or logical reasons

Relate
Show logical or causal connection between things

Solve
Give a solution for a problem; i.e., explanation in words and/or numbers

Summarize
Give a brief account of the main points

Trace
Give a step-by-step description of the development

Why
Show the cause, reason, or purpose

Appendix E

Answer Sheet

Following is a copy of the answer sheet that will be used for the 1997 Mathematics 33 diploma examinations. Teachers are encouraged to copy and use the answer sheet for their examinations in order to familiarize students with it.

LAST NAME

GIVEN NAMES

PERMANENT ADDRESS PHONE

TOWN OR CITY POSTAL CODE

ALBERTA EDUCATION STUDENT ID NUMBER

SEX

DATE OF BIRTH (YEAR/MONTH/DAY)

WRITING CENTRE — CODE

SCHOOL OF ENROLLMENT — CODE

JURISDICTION OF ENROLLMENT — CODE

IMPORTANT DIRECTIONS

1. USE HB PENCIL ONLY.
2. MAKE HEAVY BLACK MARKS THAT FILL IN THE RESPONSE CIRCLES.
3. DO NO MAKE ANY STRAY MARKS ON THIS PAPER.
4. ERASE CLEANLY ANY ANSWER YOU WISH TO CHANGE.

GRADE 12 DIPLOMA EXAMINATION

MATHEMATICS 33

Students First! Student Evaluation

Alberta Education

PLEASE DO NOT WRITE IN THIS AREA

SERIAL #

MULTIPLE CHOICE

1 Ⓐ Ⓑ Ⓒ Ⓓ	9 Ⓐ Ⓑ Ⓒ Ⓓ	17 Ⓐ Ⓑ Ⓒ Ⓓ	25 Ⓐ Ⓑ Ⓒ Ⓓ	33 Ⓐ Ⓑ Ⓒ Ⓓ	41 Ⓐ Ⓑ Ⓒ Ⓓ
2 Ⓐ Ⓑ Ⓒ Ⓓ	10 Ⓐ Ⓑ Ⓒ Ⓓ	18 Ⓐ Ⓑ Ⓒ Ⓓ	26 Ⓐ Ⓑ Ⓒ Ⓓ	34 Ⓐ Ⓑ Ⓒ Ⓓ	42 Ⓐ Ⓑ Ⓒ Ⓓ
3 Ⓐ Ⓑ Ⓒ Ⓓ	11 Ⓐ Ⓑ Ⓒ Ⓓ	19 Ⓐ Ⓑ Ⓒ Ⓓ	27 Ⓐ Ⓑ Ⓒ Ⓓ	35 Ⓐ Ⓑ Ⓒ Ⓓ	43 Ⓐ Ⓑ Ⓒ Ⓓ
4 Ⓐ Ⓑ Ⓒ Ⓓ	12 Ⓐ Ⓑ Ⓒ Ⓓ	20 Ⓐ Ⓑ Ⓒ Ⓓ	28 Ⓐ Ⓑ Ⓒ Ⓓ	36 Ⓐ Ⓑ Ⓒ Ⓓ	44 Ⓐ Ⓑ Ⓒ Ⓓ
5 Ⓐ Ⓑ Ⓒ Ⓓ	13 Ⓐ Ⓑ Ⓒ Ⓓ	21 Ⓐ Ⓑ Ⓒ Ⓓ	29 Ⓐ Ⓑ Ⓒ Ⓓ	37 Ⓐ Ⓑ Ⓒ Ⓓ	45 Ⓐ Ⓑ Ⓒ Ⓓ
6 Ⓐ Ⓑ Ⓒ Ⓓ	14 Ⓐ Ⓑ Ⓒ Ⓓ	22 Ⓐ Ⓑ Ⓒ Ⓓ	30 Ⓐ Ⓑ Ⓒ Ⓓ	38 Ⓐ Ⓑ Ⓒ Ⓓ	46 Ⓐ Ⓑ Ⓒ Ⓓ
7 Ⓐ Ⓑ Ⓒ Ⓓ	15 Ⓐ Ⓑ Ⓒ Ⓓ	23 Ⓐ Ⓑ Ⓒ Ⓓ	31 Ⓐ Ⓑ Ⓒ Ⓓ	39 Ⓐ Ⓑ Ⓒ Ⓓ	47 Ⓐ Ⓑ Ⓒ Ⓓ
8 Ⓐ Ⓑ Ⓒ Ⓓ	16 Ⓐ Ⓑ Ⓒ Ⓓ	24 Ⓐ Ⓑ Ⓒ Ⓓ	32 Ⓐ Ⓑ Ⓒ Ⓓ	40 Ⓐ Ⓑ Ⓒ Ⓓ	48 Ⓐ Ⓑ Ⓒ Ⓓ

NUMERICAL RESPONSE

1	2	3	4	5	6	7
⊙ ⊙	⊙ ⊙	⊙ ⊙	⊙ ⊙	⊙ ⊙	⊙ ⊙	⊙ ⊙
0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0
1 1 1 1	1 1 1 1	1 1 1 1	1 1 1 1	1 1 1 1	1 1 1 1	1 1 1 1
2 2 2 2	2 2 2 2	2 2 2 2	2 2 2 2	2 2 2 2	2 2 2 2	2 2 2 2
3 3 3 3	3 3 3 3	3 3 3 3	3 3 3 3	3 3 3 3	3 3 3 3	3 3 3 3
4 4 4 4	4 4 4 4	4 4 4 4	4 4 4 4	4 4 4 4	4 4 4 4	4 4 4 4
5 5 5 5	5 5 5 5	5 5 5 5	5 5 5 5	5 5 5 5	5 5 5 5	5 5 5 5
6 6 6 6	6 6 6 6	6 6 6 6	6 6 6 6	6 6 6 6	6 6 6 6	6 6 6 6
7 7 7 7	7 7 7 7	7 7 7 7	7 7 7 7	7 7 7 7	7 7 7 7	7 7 7 7
8 8 8 8	8 8 8 8	8 8 8 8	8 8 8 8	8 8 8 8	8 8 8 8	8 8 8 8
9 9 9 9	9 9 9 9	9 9 9 9	9 9 9 9	9 9 9 9	9 9 9 9	9 9 9 9

8	9	10	11	12	13	14
⊙ ⊙	⊙ ⊙	⊙ ⊙	⊙ ⊙	⊙ ⊙	⊙ ⊙	⊙ ⊙
0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0
1 1 1 1	1 1 1 1	1 1 1 1	1 1 1 1	1 1 1 1	1 1 1 1	1 1 1 1
2 2 2 2	2 2 2 2	2 2 2 2	2 2 2 2	2 2 2 2	2 2 2 2	2 2 2 2
3 3 3 3	3 3 3 3	3 3 3 3	3 3 3 3	3 3 3 3	3 3 3 3	3 3 3 3
4 4 4 4	4 4 4 4	4 4 4 4	4 4 4 4	4 4 4 4	4 4 4 4	4 4 4 4
5 5 5 5	5 5 5 5	5 5 5 5	5 5 5 5	5 5 5 5	5 5 5 5	5 5 5 5
6 6 6 6	6 6 6 6	6 6 6 6	6 6 6 6	6 6 6 6	6 6 6 6	6 6 6 6
7 7 7 7	7 7 7 7	7 7 7 7	7 7 7 7	7 7 7 7	7 7 7 7	7 7 7 7
8 8 8 8	8 8 8 8	8 8 8 8	8 8 8 8	8 8 8 8	8 8 8 8	8 8 8 8
9 9 9 9	9 9 9 9	9 9 9 9	9 9 9 9	9 9 9 9	9 9 9 9	9 9 9 9

Appendix F

Instructions for Completing the Numerical-Response Questions

- Record your answer on the answer sheet provided by writing it in the boxes and then filling in the corresponding circles.
- If an answer is a value between 0 and 1 (e.g., 0.25), then be sure to record the 0 before the decimal place.
- **Enter the first digit of your answer in the left-hand box and leave any unused boxes blank.**

Examples

Example 1

The value of tan 35° to the nearest tenth is _____.
(Record your answer on the answer sheet.)

Value: 0.7002075
Value to be recorded: 0.7

Record 0.7 on the answer sheet →

Example 2

The *y*-intercept for the quadratic function $y = 2x^2 + 7x + 32$ is _____.
(Record your answer on the answer sheet.)

Value to be recorded: 32

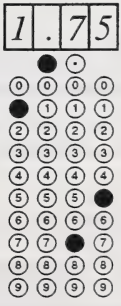
Record 32 on the answer sheet →

Example 3

If an annual interest rate of 7% is compounded quarterly, then the quarterly rate to the nearest hundredth of a percent, is _____%.
(Record your answer on the answer sheet.)

Value to be recorded: 1.75

Record 1.75 on the answer sheet →



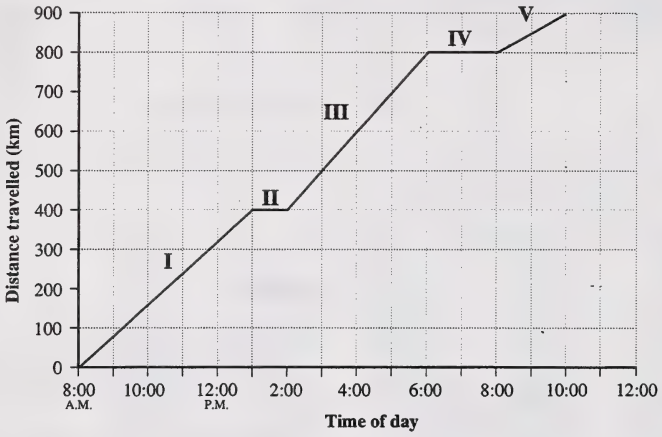
Appendix G

Sample Question and Scoring Guide

Please note the following question was scored in the 1996 Diploma Examination administration using a five-point ana-holistic scale. Teacher marking committees have recommended a five-or six-point holistic scale be used in the upcoming examination year. The 1997 examinations will reflect this recommendation. The generalized five-point scale that we plan to adapt and expand to six-points, where more sub-tasks are required to solve a problem, follows the example.

Use the following information to answer the next question.

Henry used a computer display to represent a trip his family took from Calgary to a camping spot north of Peace River. The family drove from Calgary to Barrhead, to Peace River, and by a back road to the camping spot.



Written Response – 5 marks

1. **a.** What was the total distance travelled?

A SOLUTION
The distance travelled was 900 km.

b. Interpret the horizontal segments labelled II and IV.

A SOLUTION
II and IV represent periods of rest, or when the family was not driving (i.e. walking, picnicking, etc.)

c. Henry stated that the greatest average speed occurred during segment I. Do you agree with Henry? Justify your answer.

A SOLUTION

Sample Answer:

Henry is incorrect.

Justification: Since the slopes of the lines represent the average speed, note that the slope of segment III is greater than the slope of segment I. Also, the slope of segment I is greater than the slope of segment V.

Calculations:

$$m_{\text{I}} = \frac{400 - 0}{5} = \frac{400}{5} = 80 \text{ km/h}$$

$$m_{\text{III}} = \frac{800 - 400}{4} = 100 \text{ km/h}$$

$$m_{\text{V}} = \frac{900 - 800}{2} = \frac{100}{2} = 50 \text{ km/h}$$

In symbols $m_{\text{III}} > m_{\text{I}} > m_{\text{V}}$

Thus, the family's greatest average speed is during line segment III.

DATE DUE SLIP

JUN 28 '99

F255

The followin could be adapted to questions like the prev

This scoring

5 marks
The student s shown. Steps are swers are correct, and the

4 marks
The student Final answers may be ne clarity.

3 marks
The student r as it goes, and represents a

2 marks
The student minor errors present, but

1 mark
The student l.

o continued, would lead to a of the item.

0 marks
The student

- **Either** off topic.

or

- An incorrect answer, with no supporting detail.

or

- A fatal error present. Fatal errors, whether conceptual or procedural, are those errors that destroy the integrity of the original item, often making the item completely trivial.

NR A blank paper, no response.

Minor Error Means
- calculation error
- communication error
- missing or incorrect units were applicable

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